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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicants: J.L. Hellerstein et al.
Docket No.: YOR920000146US1
Serial No.: 09/591,122
Filing Date: June 9, 2000
Group: 2123
Examiner: Kandasamy Thangavelu

I hereby certify that this paper is being deposited on this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Signature: Lisa L. Volpi Date: January 26, 2005

Title: System and Method for On-Line Adaptive Prediction Using Dynamic Management of Multiple Sub-Models

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TRANSMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith are the following documents relating to the above-identified patent application:

(1) Appeal Brief; and

(2) Copy of Notice of Appeal, filed on November 24, 2004, with copy of stamped return postcard indicating receipt of Notice by PTO on November 26, 2004.

Please charge **International Business Machines Corporation Deposit Account No. 50-0510** the amount of $500 to cover this submission under 37 CFR §1.17(c). In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 50-0510** as required to correct the error. A duplicate copy of this letter and two copies of the Appeal Brief are enclosed.

Respectfully submitted,

Robert W. Griffith

Date: January 26, 2005

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Receipt in the USPTO is hereby acknowledged of:

Transmittal Letter - 1 page
Response to Final Office Action - 4 pages
Notice of Appeal - (Orig. & 1 copy)

November 24, 2004
YOR920000146US1
Serial No. 09/591,122
1500-115

Attorney Docket No. YOR920000146US1

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APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

Sir:

Applicants (hereinafter referred to as "Appellants") hereby appeal the final rejection of claims 1-4, 6-13 and 15-20 of the above-referenced application.

REAL PARTY IN INTEREST

The present application is assigned to International Business Machines Corp., as evidenced by an assignment recorded June 9, 2000 in the U.S. Patent and Trademark Office at Reel 10863, Frame 0537. The assignee, International Business Machines Corp., is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no known related appeals and interferences.

STATUS OF CLAIMS

Claims 1-4, 6-13 and 15-20 are pending in the present application, claims 5 and 14 have been canceled. Claims 1, 8-10 and 17-19 stand rejected under 35 U.S.C. §102(b) and claims 2-4, 6, 7, 11-13, 15, 16 and 20 stand rejected under 35 U.S.C. §103(a). Claims 1-4, 6-13 and 15-20 are appealed.

STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates generally to performance management and, more particularly, to automated performance management techniques which provide on-line adaptive predictions using dynamic management of multiple sub-models (Specification, page 1, lines 4-6).

Dynamic management of sub-models according to the invention provides an ability to: (i) combine the results of sub-models; (ii) determine change points; that is, when the model is no longer a faithful characterization of the process; (iii) identify the sub-model(s) to exclude when a change point occurs and/or as more data is acquired; (iv) identify the sub-model(s) to include when a change point occurs and/or as more data is acquired; and (v) manage training and test data in a way to accomplish the above objectives (Specification, page 5, lines 10-16).

In one aspect of the present invention, an on-line adaptive prediction system employing dynamic management of multiple sub-models may comprise the following components in order to address the foregoing objectives. A sub-model combiner component combines sub-models. This is in part based on information in the model context that includes combining functions that specify how the results of sub-models should be combined. A model assessor component computes residuals of the model and checks for change points. A model adapter component determines the sub-models to include and/or exclude, updating the model context as needed. Training data is maintained separately by each sub-model to enable the dynamic inclusion and exclusion of sub-models. Test data is managed by the model assessor component (Specification, page 5, lines 17-26).

The present invention provides two central processes. The first details the steps taken when new measurement data is made available to the prediction system. In one aspect of the invention,

the process includes steps for: (a) updating test data; (b) updating training data of each sub-model and its estimates of parameters; (c) testing for change points; and (d) determining the best combination of sub-models based on the results of change point detection and other factors. The second process details the actions performed when an application requests a prediction. In one aspect of the invention, this process includes the steps of: (a) determining the input parameters for each sub-model; (b) requesting predictions from each sub-model; and (c) combining the results (Specification, page 6, lines 1-9).

A block diagram illustrating an overall architecture of an environment in which an on-line adaptive prediction system employing dynamic management of multiple sub-models may operate is shown in FIG. 1. A block diagram illustrating an on-line adaptive prediction system employing dynamic management of multiple sub-models is shown in FIG. 2. A flow diagram illustrating a process for handling data updates in an on-line adaptive prediction system employing dynamic management of multiple sub-models is shown in FIG. 4. A flow diagram illustrating a process for handling prediction requests in a an on-line adaptive prediction system employing dynamic management of multiple sub-models is shown in FIG. 5.

The present invention provides numerous benefits to developers of systems that require a predictive capability for non-stationary processes. First, accuracy can be improved by choosing the best combination of sub-models. The invention supports this by having a flexible technique for sub-model inclusion and exclusion, as well as a means to test for change points (Specification, page 6, lines 10-14). Second, the present invention provides methodologies to adjust incrementally the model as more data is available for parameter estimation. Accurate models often require considerable data to estimate parameters. However, less accurate models are possible if the data available is modest (Specification, page 6, lines 15-18). Third, the modular structure provided by the present invention greatly facilitates the incremental inclusion and exclusion of sub-models, as well as the manner in which they are combined. Thus, it is much easier to update the model than would be the case in a technique that hard codes sub-models and their relationships (Specification, page 6, line 26 through page 7, line 2).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(I) Claims 1, 8-10 and 17-19 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,793,429 to Kim et al. (hereinafter "Kim").

(II) Claims 2, 3, 6, 7, 11, 12, 15, 16 and 20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kim in view of Hellerstein et al., IEEE, May 1999 (hereinafter "Hellerstein").

(III) Claims 4 and 13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kim in view of Hellerstein and Hellerstein et al., Conference of the Computer Measurement Group, December 1998 (hereinafter Hellerstein-2).

ARGUMENT

Appellants incorporate by reference herein the disclosures of all previous responses filed in the present application, namely, responses dated November 24, 2003, May 26, 2004 and November 24, 2004. Sections (I), (II) and (III) to follow will respectively address grounds (I), (II) and (III) presented above.

(I) With regard to the rejection of claims 1, 8-10 and 17-19 under 35 U.S.C. §102(b) as being anticipated by Kim, Appellants assert that Kim fails to provide the necessary disclosure required to sustain a §102(b) rejection.

It is well-established law that a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). Appellants again assert that the rejection based on Kim does not meet this basic legal requirement. Support for this assertion follows.

Independent claims 1, 10 and 19 recite techniques for providing on-line adaptive predictions for use by one or more applications and used in association with one or more operations for which predictions may be requested. The predictions are performed in accordance with at least one model, which includes one or more sub-models. At least one of the one or more sub-models are adapted and an optimum combination of sub-models is determined to be used in computing on-line predictions when a change is detected in data associated with the one or more operations for which

predictions may be requested. One or more predictions are computed in response to one or more requests from the one or more applications, using the one or more sub-models determined to provide an optimum prediction combination.

Kim discloses methods of estimating motion in image data. However, Kim fails to disclose the determination of an optimum combination of sub-models to be used in computing on-line predictions, when a change is detected in data associated with the one or more operations for which predictions may be requested. Kim also fails to disclose the computing of one or more predictions, in response to one or more requests from the one or more applications, using the one or more sub-models determined to provide an optimum prediction combination.

In the final Office Action, the Examiner contends that Kim teaches the selection of a best model which yields the smallest sum of absolute difference error, where each model includes multiple elementary models. Appellants strongly disagree. In providing support for the rejection the Examiner first refers to a portion of Kim describing the determination of an optimum motion vector by predicting a plurality of motion vectors based on a corresponding plurality of motion models and selecting the best model and vector which yields the smallest sum of absolute difference error. When an optimum motion vector is predicted, previously read motion vectors are adjusted relative to the optimum motion vector in order to provide an estimate of motion in an image data frame. There is no disclosure of a determination of an optimum combination of sub-models, nor a computation of a prediction using the optimum combination of sub-models.

The Examiner also refers to a portion of Kim describing a 3-D spatial model that includes multiple elementary models to effectively treat motion discontinuity. In the 3-D spatial model, motion in a reference block is predicted by combining information about a motion vector field in a coarser resolution image and information about the motion vector field in circumferential blocks. Again, there is no disclosure of a determination of an optimum combination of sub-models, nor a computation of a prediction using the optimum combination of sub-models.

Appellants also assert that the use of these portions of Kim in combination cannot be reconciled. It is not clear how the determination of an optimum vector that yields a smallest sum of absolute difference error may be used in combination with a 3-D spatial model that includes multiple elementary models to disclose the invention recited in independent claims 1, 10 and 19 of the present

invention. Finally, assuming *arguendo* that the combination may be reconciled, Kim fails to disclose or suggest a determination of an optimum combination of sub-models and the computation of predictions using the optimum combination of sub-models.

Further, on page 10, paragraph 2, of the final Office Action the Examiner states that it would have been obvious to one of ordinary skill in the art that Kim teaches selecting an optimal combination of sub-models. This statement alone demonstrates that Kim does not provide the proper disclosure in order to sustain a §102(b) rejection.

Thus, a §102(e) rejection based on Kim fails to meet the basic legal requirement of *Verdegaal Bros. v. Union Oil Co. of California* (cited above), i.e., a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. Support for the rejection does not come expressly from Kim, as explained above. Further, in an Advisory Action the Examiner contends that "it is inherent that each of the plurality of motion models used for predicting the plurality of motion vectors comprises several elementary or sub-models." However, there is no argument made in the final Office Action or Advisory Action supporting inherency. According to the Federal Circuit, "[i]nherency does not embrace probabilities or possibilities." Trintec Industries, Inc. v. Top-U.S.A. Corp., 295 F.3d 1292, 1297, 63 USPQ2d 1597 (Fed. Cir. 2002). Further, an inherent anticipation requires that the missing descriptive material is necessarily present, and not merely probably or possibly present, in the prior art. In re Robertson, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999). Thus, the alleged inherent feature must flow from the reference, and it is not sufficient to state that the alleged inherent feature could flow from the reference. Kim does not disclose the material necessary to support a rejection based on inherency.

Appellants respectfully assert that claims 8, 9, 17 and 18 are patentable over Kim not only due to their respective dependence from independent claims 1 and 10, but also because such claims respectively recite patentable subject matter in their own right. Accordingly, withdrawal of the §102(b) rejection of claims 1, 8-10 and 17-19 is respectfully requested.

(II) Regarding the §103(a) rejection of claims 2, 3, 6, 7, 11, 12, 15, 16 and 20 based on a combination of Kim and Hellerstein, Appellants respectfully assert that the cited combination fails

As set forth therein, M.P.E.P. §2143 states that three requirements must be met to establish a prima facie case of obviousness. First, the cited combination must teach or suggest all the claim limitations. Second, there must be a reasonable expectation of success. Third, there must be some suggestion or motivation to combine reference teachings. While it is sufficient to show that a prima facie case of obviousness has not been established by showing that one of the requirements has not been met, Appellants respectfully believe that none of the requirements have been met.

First, with respect to claims 2, 3, 6, 7, 11, 12, 15, 16 and 20, the collective teaching of Kim and Hellerstein fails to suggest or render obvious the elements of such claims. For at least this reason, a prima facie case of obviousness has not been established.

Claims 2, 3, 6 and 7 are dependent on independent claim 1, claims 11, 12, 15 and 16 are dependent on independent claim 10, and claim 20 is dependent on independent claim 19. The failure of Kim to disclose the elements recited in independent claims 1, 10 and 19 is described above. Hellerstein discloses the prediction of violations of threshold tests for specific times in the future at a nonstationary behavior level and stationary time-serial dependencies level. However, the combination of Kim and Hellerstein also fails to disclose those elements of independent claims 1, 10 and 19 described above. The combination of Kim and Hellerstein also fails to disclose the limitations provided in the dependent claims. For example, the combination fails to disclose an adapting operation that estimates one or more parameters associated with each of the one or more sub-models based on data received with respect to the detected change, as recited in claim 2. Therefore, the combination of Kim and Hellerstein fails to teach or suggest all the limitations of claims 2, 3, 6, 7, 11, 12, 15, 16 and 20.

Second, with respect to claims 2, 3, 6, 7, 11, 12, 15, 16 and 20, Appellants reassert that there is no reasonable expectation of success in achieving the present invention through a combination of Kim and Hellerstein. For at least this reason, a prima facie case of obviousness has not been established. Despite the assertion in the final Office Action, Appellants do not believe that Kim and Hellerstein are combinable since it is not clear how one would combine them. No guidance was provided in the final Office Action as to how the two references can be combined to achieve the present invention. However, even if combined, for the sake of argument, they would not achieve the techniques of the claimed invention.

Third, with respect to claims 2, 3, 6, 7, 11, 12, 15, 16 and 20, Appellants reassert that no motivation or suggestion exists to combine Kim and Hellerstein in a manner proposed by the Examiner, or to modify their teachings to meet the claim limitations. For at least this reason, a prima facie case of obviousness has not been established.

Furthermore, the Federal Circuit has stated that when patentability turns on the question of obviousness, the obviousness determination "must be based on objective evidence of record" and that "this precedent has been reinforced in myriad decisions, and cannot be dispensed with." In re Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002). Moreover, the Federal Circuit has stated that "conclusory statements" by an examiner fail to adequately address the factual question of motivation, which is material to patentability and cannot be resolved "on subjective belief and unknown authority." Id at 1343-1344.

For example, with regard to claim 2, in the final Office Action, in paragraph 6.1 of page 6, the Examiner provides the following statement to prove motivation to combine Kim and Hellerstein, with emphasis supplied: "It would have been obvious . . . to modify the apparatus of KI with the apparatus of HE that included the adapting operation further comprising estimating one or more parameters associated with each of the one or more sub-models based on data received with respect to the detected change, as that would enable predicting the time-varying or nonstationary behavior of the measurement variable and the stationary, time-serial dependencies of the variable." Similar statements are provided for claims 3, 6, 7, 11, 12, 15, 16 and 20.

Appellants submit that these statements are based on the type of "subjective belief and unknown authority" that the Federal Circuit has indicated provides insufficient support for an obviousness rejection. More specifically, the Examiner fails to identify any objective evidence of record which supports the proposed combination. Therefore, for at least the reasons given above, Appellants again respectfully request that the §103(a) rejections of claims 2, 3, 6, 7, 11, 12, 15, 16 and 20 be withdrawn.

(III) Regarding the §103(a) rejection of claims 4 and 13 based on a combination of Kim, Hellerstein and Hellerstein2, Appellants respectfully assert that the cited combination fails to establish a prima facie case of obviousness under 35 U.S.C. §103(a), as specified in M.P.E.P. §2143.

First, with respect to claims 4 and 13, the collective teaching of Kim, Hellerstein and Hellerstein-2 fails to suggest or render obvious the elements of such claims. For at least this reason, a prima facie case of obviousness has not been established.

Claim 4 is dependent on independent claim 1, and claim 13 is dependent on independent claim 10. The failure of Kim to disclose the elements recited in independent claims 1 and 10 is described above. Hellerstein discloses the prediction of violations of threshold tests for specific times in the future at a nonstationary behavior level and stationary time-serial dependencies level. Hellerstein-2 discloses a systematic, statistical approach to characterizing normal system operation for time varying workloads in a web server, considering the influence of time-of-day, day-of-week, and month as well as time serial correlation as applied to workload forecasting and problem detection. However, the combination of Kim, Hellerstein and Hellerstein-2 also fails to disclose those elements of independent claims 1 and 10 described above. The combination of Kim, Hellerstein and Hellerstein-2 also fails to disclose the limitations provided in the dependent claims. For example, the combination fails to disclose an adapting operation that tests for a change-point condition. Therefore, the combination of Kim, Hellerstein and Hellerstein-2 fails to teach or suggest all the limitations of claims 4 and 13.

Second, with respect to claims 4 and 13, Appellants reassert that there is no reasonable expectation of success in achieving the present invention through a combination of Kim, Hellerstein and Hellerstein-2. For at least this reason, a prima facie case of obviousness has not been established. Despite the assertion in the final Office Action, Appellants do not believe that Kim, Hellerstein and Hellerstein-2 are combinable since it is not clear how one would combine them. No guidance was provided in the final Office Action as to how the two references can be combined to achieve the present invention. However, even if combined, for the sake of argument, they would not achieve the techniques of the claimed invention.

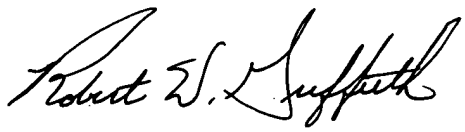
Third, with respect to claims 4 and 13, Appellants reassert that no motivation or suggestion exists to combine Kim, Hellerstein and Hellerstein-2 in a manner proposed by the Examiner, or to modify their teachings to meet the claim limitations. For at least this reason, a prima facie case of obviousness has not been established.

For example, with regard to claim 4, in the final Office Action, in paragraph 7.1 of page 9, the Examiner provides the following statement to prove motivation to combine Kim, Hellerstein and Hellerstein-2, with emphasis supplied: "It would have been obvious . . . to modify the apparatus of KI with the apparatus of HEL that included adapting operation further comprising testing for a change-point condition, as that would allow detection of anomalies, such as an increase in the mean or variance, using an on-line technique that examines the observations in sequence.

Appellants submit that these statements are based on the type of "subjective belief and unknown authority" that the Federal Circuit has indicated provides insufficient support for an obviousness rejection. More specifically, the Examiner fails to identify any objective evidence of record which supports the proposed combination. Therefore, for at least the reasons given above, Appellants again respectfully request that the §103(a) rejections of claims 4 and 13 be withdrawn.

For at least the reasons given above, Appellants respectfully request withdrawal of the §102(b) and §103(a) rejections of claims 1-4, 6-13 and 15-20. Appellants believe that claims 1, 8-10 and 17-19 are patentable over Kim, and claims 2-4, 6, 7, 11-13, 15, 16 and 20 are not obvious in view of Kim, Hellerstein and Hellerstein-2. As such, the application is asserted to be in condition for allowance, and favorable action is respectfully solicited.

Respectfully submitted,



Date: January 26, 2005

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APPENDIX

1. Apparatus for providing on-line adaptive predictions for use by one or more applications used in association with one or more operations for which predictions may be requested, the predictions being performed in accordance with at least one model which includes one or more sub-models, the apparatus comprising:

at least one processor operative to at least one of: (i) adapt at least one of the one or more sub-models and determine an optimum combination of sub-models, to be used in computing on-line predictions, when a change is detected in data associated with the one or more operations for which predictions may be requested; and (ii) compute one or more predictions, in response to one or more requests from the one or more applications, using the one or more sub-models determined to provide an optimum prediction combination.

2. The apparatus of claim 1, wherein the adapting operation further comprises estimating one or more parameters associated with each of the one or more sub-models based on data received with respect to the detected change.

3. The apparatus of claim 2, wherein the one or more estimated parameters for a sub-model are used to update a descriptor associated with the sub-model.

4. The apparatus of claim 2, wherein the adapting operation further comprises testing for a change-point condition.

6. The apparatus of claim 1, wherein a sub-model maintains data used to estimate one or more parameters associated therewith.

7. The apparatus of claim 1, wherein a sub-model at least one of computes and stores one or more values associated with one or more sub-model parameters.

8. The apparatus of claim 1, wherein the prediction computing operation further comprises computing a prediction for each of the one or more sub-models determined to provide the optimum prediction combination.

9. The apparatus of claim 8, wherein the prediction computing operation further comprises combining the results of the one or more computed predictions.

10. A method of providing on-line adaptive predictions for use by one or more applications used in association with one or more operations for which predictions may be requested, the predictions being performed in accordance with at least one model which includes one or more sub-models, the method comprising at least one of the steps of:

adapting at least one of the one or more sub-models and determining an optimum combination of sub-models, to be used in computing on-line predictions, when a change is detected in data associated with the one or more operations for which predictions may be requested; and

computing one or more predictions, in response to one or more requests from the one or more applications, using the one or more sub-models determined to provide an optimum prediction combination.

11. The method of claim 10, wherein the adapting step further comprises estimating one or more parameters associated with each of the one or more sub-models based on data received with respect to the detected change.

12. The method of claim 11, wherein the one or more estimated parameters for a sub-model are used to update a descriptor associated with the sub-model.

13. The method of claim 11, wherein the adapting step further comprises testing for a change-point condition.

15. The method of claim 10, wherein a sub-model maintains data used to estimate one or more parameters associated therewith.

16. The method of claim 10, wherein a sub-model at least one of computes and stores one or more values associated with one or more sub-model parameters.

17. The method of claim 10, wherein the prediction computing step further comprises computing a prediction for each of the one or more sub-models determined to provide the optimum prediction combination.

18. The method of claim 17, wherein the prediction computing step further comprises combining the results of the one or more computed predictions.

19. An article of manufacture for providing on-line adaptive predictions for use by one or more applications used in association with one or more operations for which predictions may be requested, the predictions being performed in accordance with at least one model which includes one or more sub-models, comprising a machine readable medium containing one or more programs which when executed implement at least one of the steps of:

adapting at least one of the one or more sub-models and determining an optimum combination of sub-models, to be used in computing on-line predictions, when a change is detected in data associated with the one or more operations for which predictions may be requested; and

computing one or more predictions, in response to one or more requests from the one or more applications, using the one or more sub-models determined to provide an optimum prediction combination.

20. The article of claim 19, wherein a sub-model maintains data used to estimate one or more parameters associated therewith.